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OFFICE OF
PREVENTION, PESTICIDES AND
TOXIC SUBSTANCES

September 16, 1999

Memorandum

SUBJECT: **Revised** Naled Mosquito Control Use Bystander Exposure Assessment for Ground-based and Aerial Applications. DP Barcode D258431. PC Code 034401.

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This revised memo addresses the potential bystander exposure to naled from the mosquito control applications. The revisions to the original document (D252224) are based on information changing the initial turf transferable residue for dermal exposure from 20 to 5 percent. Chemical-specific data are not available. Therefore, literature studies, the AgDrift Model, and the Residential SOPs were used to develop a screening-level assessment. The use of the literature and Ag Drift Model is consistent with the assessment that was developed in the fenthion RED. Since this is an insert into the RED, the toxicological data are not presented.

Executive Summary

The resulting screening-level bystander MOEs for naled **mosquito** control uses indicate that MOEs are greater than 100 for all postapplication exposure scenarios. The only scenario of concern is the dermal turf contact for adults and toddlers for the aerial **blackfly** control applications with MOEs of approximately 50. If the dermal absorption factor for naled is similar to the other two analogs, dichlorvos and trichlorfon, then these MOEs for the blackfly control are not of concern. To better characterize the dermal absorption of naled, it is recommended that a dermal absorption study in rats be conducted. Results of the MOE calculations are presented in Table 1.

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Residential Post-Application Exposures and Assumptions

HED has determined that there are potential bystander post-application exposures to residents even though residential uses have been voluntarily canceled by the registrant. The potential residential bystander exposures to adults and children result from aerial and ground-based fogger blackfly and mosquito control uses. Potential exposures are estimated because of the concern for the residues that may be deposited during the ultra low volume (ULV) aerial and ground-based fogger applications in the vicinity of residential dwellings. This assessment has been developed to ensure that the potential exposures are not underestimated and to represent a conservative model that encompasses potential exposures received in other recreational areas (e.g., school playgrounds, parks, athletic fields). The scenarios likely to result in postapplication exposures are listed in Table 1 and are as follows:

- Dermal exposure from residues deposited on turf (adult and child);
- Incidental nondietary ingestion of residues deposited on lawns from hand-to-mouth transfer (toddler);
- Incidental nondietary ingestion of residues deposited on lawns from object-to-mouth transfer (toddler); and
- Incidental ingestion of soil from treated areas (toddler).

Although the incidental ingestion of soil and object-to-mouth scenarios are not expected to contribute significantly in comparison to the dermal route and/or the hand-to-mouth activity, they are included in this assessment to account for all potential pathways of exposure. It is unnecessary to include these pathways in the aggregate exposure because they would be rounded out of the final value.

Chemical-specific data for mosquito uses are not available. Therefore, the equations and assumptions used for each of these four scenarios were taken from the Draft Standard Operating Procedures (SOPs) for Residential Exposure Assessments guidance document, and are provided below. Note: The initial turf transferable residue level has been modified using additional information that has become available since the publishing of the SOPs. Although the SOPs were initially developed for direct turf applications, the models are used in this assessment to determine if there is a potential concern using a screening level approach. In addition to the use of the SOPs, the unique nature of the mosquito control uses requires additional information in determining the deposition rate of naled (i.e., amount of ai deposited on residential turf) because the application technique is meant to keep the spray aloft. The determination of the deposition rates are consistent with HED's assessment developed in the fenthion RED. The following information was used to determine the deposition rates for ground-based foggers and aerial applications.

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Ground-based Foggers:

In the study conducted by Moore *et al.*, [*Downwind Drift and Deposition of Malathion on Human Targets From Ground Ultra-Low Volume Mosquito Sprays*: J.C. Moore, J.C. Dukes, J.R. Clark, J. Malone, C.F. Hallmon, and P.G. Hester; Journal of the American Mosquito Control Association; Vol. 9, No. 2 (June, 1993)] both human exposure and deposition was quantified over 5 separate application events. A 91 percent formulation of malathion was applied in April and May of 1989 in the early evening (a time of day for relative atmospheric stability). A Leco HD ULV cold aerosol generator (Lowndes Engineering Company, Valdosta Georgia) was used to make each application. The application parameters included a fluid flow rate of 4.3 fluid ounces per minute, a vehicle groundspeed of 10 mph, and a nominal application rate of 0.05 lb ai/acre (i.e., equates to a deposition rate of 0.56 $\mu g/cm^2$). Deposition was monitored at three locations downwind from the treatment area (i.e., 15.2 m, 30.4 m, and 91.2 m). For the events considered in the deposition calculations, "average amounts of malathion deposited on ground level at 15.2, 30.4, and 91.2 m were not significantly different." The percentage of the application rate reported to have deposited ranged from 1 to 14 percent. The mean deposition value for all measurements was 4.3 percent (n=35, CV=98).

In the study conducted by Tietze *et al.*, [*Mass Recovery of Malathion in Simulated Open Field Mosquito Adulticide Tests*: N.S. Tietze, P.G. Hester, and K.R. Shaffer; Archives of Environmental Contamination and Toxicology; 26: 473-477 (1994)] only deposition was quantified over 6 separate application events (i.e., one event was not included in deposition calculations "due to negative air stability"). The application parameters were similar to that used by Moore *et al.* A 95 percent formulation of malathion was applied from May to August of 1993. A Leco 1600 ULV cold aerosol generator (Lowndes Engineering Company, Valdosta Georgia) was also used to make each application. The application parameters included a fluid flow rate of 4.3 fluid ounces per minute, a vehicle groundspeed of 10 mph, and a nominal application rate of 0.057 lb ai/acre (i.e., equates to a deposition rate of 0.64 $\mu g/cm^2$). Deposition was monitored at four locations downwind from the treatment area (i.e., 5 m, 25 m, 100 m and 500 m). For the events considered in the deposition calculations, "malathion mass deposited differed significantly between the 500 m site and the three closer sites ($df = 3$; F-value = 3.42; $P<0.05$)." The percentage of the application rate reported to have deposited (not including 500 m samples which were much less) ranged up to 5.8 percent. The mean deposition value for all measurements was 3.8 percent.

After considering the data that are available in the Tietze *et al.* and Moore *et al.* papers, an off-target deposition rate of 5 percent of the application rate was used by HED to evaluate ground-based ULV applications (i.e., 5 percent of application rate is the deposition rate of which 20 percent is assumed to be available for dislodging). A value slightly higher than the mean values for both studies was selected because of the variability in the data and the limited number of data points. It should be noted that this value is also consistent with the draft modeling assessment for ground-ULV approaches completed by S.T. Perry and W.B.

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Petersen of EPA's Office of Research and Development (i.e., within a factor of 5). Perry and Petersen used "the INPUFF Lagrangian puff model" as the basis for their assessment (Petersen and Lavdas, 1986: *INPUFF 2.0 - A Multiple Source Gaussian Puff Dispersion Algorithm, User's Guide*, EPA/600/8-86/024). Depending on the scenario selected from this document, deposition rates ranged from approximately 2.5 percent deposition 450 m downwind to 15 to 20 percent deposition **immediately adjacent** to the treatment zone.

Aerial Applications:

Data similar to that for ground applications discussed above were not available for the aerial deposition. Therefore, in order to calculate deposition from aerial ULV applications, HED used *AgDRIFT* (V 1.03 -- June 1997) which is the model that was developed as a result of the efforts of the *Spray Drift Task Force (SDTF)*. For a more comprehensive discussion of the model selection for malaria vector control applications, readers are referred to the Agency's fenthion RED. In summary, the SDTF is a coalition of 38 pesticide registrants whose primary objectives were to develop a comprehensive database of off-target drift information in support of pesticide registrations and an appropriate model system. This model was selected based on the consensus of several experts in the spray drift area because it represents the current state-of-the-art. It is important to note that no proprietary SDTF data were used in the completion of this assessment. The following inputs were used as the basis of the *AgDRIFT* calculations:

- **AgDRIFT Model Tier:** 3.

- **Droplet Size Distribution:** $D_{v0.1}$ = 39.02 μm; $D_{v0.5}$ = 54.82 μm; $D_{v0.9}$ = 77.5 μm; and < 141 μm = 98 percent (developed to reflect droplet spectrum requirements of Trumpet label). **[Note: The droplet distribution was developed based on the Trumpet label. No proprietary SDTF data were used in the completion of this assessment.]**

- **Spray Material:** User-defined option (oil option). Inputs include: nonvolatile rate 2.5 lb per acre, specific gravity 1.2 (calculated based on approximately 10 pounds per gallon), spray rate 0.25 gallons/acre, active ingredient application rate (0.1 lb ai/acre), and evaporation rate (1 μm^2/deg C/sec). [Note: Several of these parameters do not exactly coincide with the Trumpet label but were used because the Trumpet label inputs exceeded the allowable input parameters. These differences are not expected to significantly affect the AgDRIFT results because a nonvolatile oil was selected, hence the critical input is the active ingredient application rate. Additionally, **no proprietary SDTF physical property data were used in the completion of this assessment.]**

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- **Aircraft:** User-defined option (fixed-wing option). Inputs include: Douglas DC3, wingspan: 94.6 ft (semispan 47.28 ft), typical application airspeed: 228 mph, weight: 21397 pounds, planform area: 1009.63 ft^2, propeller RPM: 2550, propeller radius: 5.81 feet, engine vertical distance: -1.22 feet, and engine forward distance: 6.1 feet. [Note: DC3-specific inputs were obtained from the *FSCBG (V4)* aircraft library.]

- **Nozzles:** User-defined option. Inputs include number of nozzles: 60, vertical distance of nozzles from wing: -2.66 feet, horizontal distance from wing: -0.82 feet, and horizontal distance limit: 75 percent.

- **Meteorology:** Inputs were not changed from Tier 3 recommendations of wind speed: 2 mph, wind direction: -90 degrees (perpendicular to flight path), temperature: 86°F, and relative humidity: 50 percent.

- **Control:** Inputs were altered from the Tier 3 recommendations. The parameters that were used included a spray release height of 300 feet, 20 spray lines (aircraft passes) in each application event, a swath width of 500 feet, and a swath displacement based on the aircraft centerline.

- **Advanced Settings:** Inputs were not changed from Tier 3 recommendations of wind speed height (2 meters), maximum compute time (600 seconds), maximum downwind distance (795 meters), vortex decay rate (0.56 m/s), aircraft drag coefficient (0.1), propeller efficiency (0.8), and ambient pressure (1013 mb).

AgDRIFT is capable of producing a variety of useful outputs. The key for HED in this assessment was to determine from the model what percentage of the application volume remained aloft and what percentage of the resulting droplets deposited on the surfaces in the treatment area as well as downwind from the treatment area. AgDRIFT is generally intended to calculate deposition rates in areas that are downwind from the treatment area (i.e., presented from the border of the treatment area to areas of interest downwind). HED has used the values at the border of the treatment area to represent the deposition rate within the treated area. The results that HED used to determine the percentage of application rate that is deposited are presented in Figure 1 (Tier 3 Deposition presented as a Fraction of Application Rate vs. Distance Downwind). It is clear from Figure 1 that from the edge of the treatment area to 2000 feet downwind, approximately 30 percent of the theoretical application is deposited.

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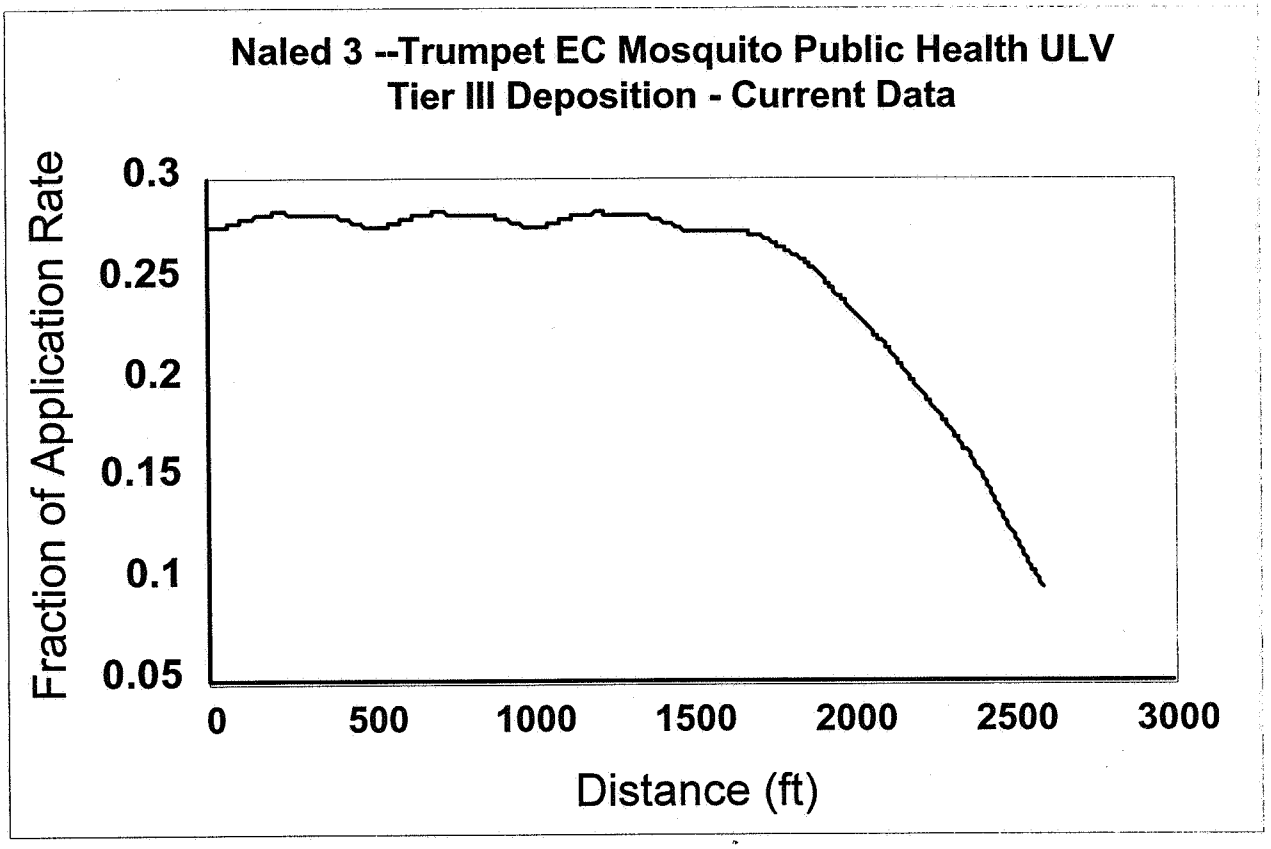
Naled 3 --Trumpet EC Mosquito Public Health ULV
Tier III Deposition - Current Data
Fraction of Application Rate
0.3
0.25
0.2
0.15
0.1
0.05
0
500
1000
1500
2000
2500
3000
Distance (ft)

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General Assumptions:

- The amount of residue deposited on the turf from aerial application is 30 percent of the application rate and ground-based foggers are assumed to deposit 5 percent of the application rate.

- Five percent of the amount of residue deposited from the mosquito application is available from the turfgrass as a transferable residue for dermal exposure. Twenty percent is available for oral exposure (e.g., hand-to-mouth). The percent available for oral exposure is expected to be higher because to account for a child's "sticky" hands.

- Postapplication was assessed on the same day the pesticide is applied because it was assumed that adults and children could be exposed to turfgrass immediately after application. Therefore, postapplication exposures were based on day 0.

- Adults were assumed to weigh 70. Toddlers (3 years old), used to represent the 1 to 6 year old age group, were assumed to weigh 15 kg.

- Application rates for mosquito aerial applications range from 0.05 to 0.1 lb ai/acre. The 0.05 lb ai/acre rate is the mosquito rate used for residential areas while the 0.1 lb ai/acre rate is the maximum labeled rate and is used for mosquito treatments in areas of heavy vegetation (i.e., not residential areas). The residential blackfly rate is 0.1 lb ai/acre and the labeled maximum rate for blackfly treatments is for heavy vegetation areas -- 0.25 lb ai/acre. The labeled maximum rates are not assessed for postapplication exposure because these rates are intended for heavy vegetation areas that are not likely to occur in residential areas.

- Specific assumptions related to each of the four exposure scenarios are discussed below.

Dermal exposure:

Potential dermal exposures to adults and toddlers engaged in a high-end exposure activity (e.g., playing and rolling on turf) are estimated using the following equation:

$$ADD = (DFR_t * CF1 * Tc * ET) / BW$$

where:

ADD = average daily dose (mg/kg/day)
DFR_t = dislodgeable foliar residue on day "t" ($\mu g/cm^2$)
CF1 = weight unit conversion factor to convert μg units in the DFR value to mg for the daily dose (0.001 mg/μg)

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Tc = transfer coefficient (cm^2/hr)
ET = exposure time (hr/day)
BW = body weight (kg)

and

$$DFR_t = AR * F * (1-D)^t * CF2 * CF3$$

where:

AR = application rate (lb ai/acre) x percentage deposited (i.e., 30 percent for aerial and 5 percent for ground-based foggers)
F = fraction of ai available on the foliage as dislogeable residue (0.05 for dermal and 0.20 for oral routes, unitless)
D = fraction of residue that dissipates daily (0.10, unitless)
t = postapplication day on which exposure is being assessed (day 0)
CF2 = weight unit conversion factor to convert the lbs ai in the application rate to μg for the DFR value (4.54E8 μg/lb)
CF3 = area unit conversion factor to convert the surface area units (ft^2) in the application rate to cm^2 for the DFR value (2.47E-8 acre/cm^2 if the application rate is per acre)

- The mean dermal transfer coefficient representing a high contact activity (e.g., playing and rolling on turf) was assumed to be 43,000 cm^2/hr for adults and 8,700 cm^2/hr for toddlers. At this time, these transfer coefficients are the best available data to estimate potential contact to turf for these types of activities.

- The duration of exposure for toddlers and adults was assumed to be 2 hours per day (95th percentile duration for playing on grass, Exposure Factors Handbook).

Hand-to-mouth:

Incidental ingestion resulting from a child's hand in their mouth is estimated using the following equation and assumptions:

$$ADD = (DFR_t * SA * FQ * ET * CF1) / BW$$

where:

ADD = average daily dose (mg/kg/day)
DFR_t = dislodgeable foliar residue on day "t" (μg/cm^2 turf) -- see Dermal above
SA = surface area of the hands (cm^2/event)
FQ = frequency of hand-to-mouth activity (events/hr)
ET = exposure time (hr/day)

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CF1 = weight unit conversion factor to convert μg units in the DFR value to mg for the daily exposure (0.001 mg/μg)
BW = body weight (kg)

- The median surface area of both hands was assumed to be 350 cm^2 for a toddler (age 3 years).
- Replenishment of the hands with pesticide residues was assumed to be an implicit factor in this assessment.
- It was assumed that there is a one-to-one relationship between the dislodgeable residues on the turf and on the surface area of the skin after contact (i.e., if the dislodgeable residue on the turf is 1 mg/cm^2, then the residue on the human skin is also 1 mg/cm^2 after contacting the turf).
- The mean rate of hand-to-mouth activity is 0.026 events/minute (i.e., 1.56 events/hr) for toddlers (3 to 5 years old).
- The duration of exposure for toddlers was assumed to be 2 hours per day (95th percentile duration for playing on grass, Exposure Factors Handbook).

Object-to-mouth:

"Mouthing" of a toy or handful of grass by a toddler is estimated using the following equation and assumptions:

$$ADD = (GR_t * IgR * CF1) / BW$$

where:
ADD = average daily dose (mg/kg/day)
GR_t = object (e.g., toy or grass) residue on day "t" (μg/cm^2)
IgR = surface area of object (cm^2/day)
CF1 = weight unit conversion factor to convert the μg of residues on the object to mg to provide units of mg/day (1E-3 mg/μg)
BW = body weight (kg)

and

$$GR_t = AR * F * (1-D)^t * CF2 * CF3$$

where:
AR = application rate (lb ai/acre) x percentage deposited (i.e., 30 percent for aerial and 5 percent for ground-based fogger)

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F = fraction of ai available on the object (0.20, unitless)
D = fraction of residue that dissipates daily (unitless)
t = postapplication day on which exposure is being assessed
CF2 = weight unit conversion factor to convert the lbs ai in the application rate to μg for the object residue value (4.54E8 μg/lb)
CF3 = area unit conversion factor to convert the surface area units (ft^2) in the application rate to cm^2 for the object residue value (2.47E-8 acre/cm^2 if the application rate is per acre)

- The assumed surface area of an object for mouthing for toddlers (age 3 years) is 25 cm^2/day (i.e., 2 x 2 inches or 4 in^2). This value was intended to represent the approximate area from which a child may grasp a handful of grass or mouth a toy.

Incidental Soil Ingestion:

Ingestion of soil by a toddler is estimated using the following equation and assumptions:

$$ADD = (SR_t * IgR * CF1) / BW$$

where:

ADD = average daily dose (mg/kg/day)
SR_t = soil residue on day "t" (μg/g)
IgR = ingestion rate of soil (mg/day)
CF1 = weight unit conversion factor to convert the μg of residues on the soil to grams to provide units of mg/day (1E-6 g/μg)
BW = body weight (kg)

and

$$SR_t = AR * F * (1-D)^t * CF2 * CF3 * CF4$$

where:

AR = application rate (lb ai/acre) x percentage deposited (i.e., 30 percent for aerial and 5 percent for ground-based foggers)
F = fraction (100 percent) of ai available in uppermost cm of soil (fraction/cm)
D = fraction of residue that dissipates daily (unitless)
t = postapplication day on which exposure is being assessed
CF2 = weight unit conversion factor to convert the lbs ai in the application rate to μg for the soil residue value (4.54E8 μg/lb)
CF3 = area unit conversion factor to convert the surface area units (ft^2) in the application rate to cm^2 for the SR value (2.47E-8 acre/cm^2 if the application rate is per acre)
CF4 = volume to weight unit conversion factor to convert the volume units (cm^3) to weight units for the SR value (U.S. EPA, 1992) (0.67 cm^3/g soil)

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- On the day of application, it was assumed that 30 percent for aerial and 5 percent for ground-based foggers of the application rate are located within the soil's uppermost 1 cm.

- The assumed soil ingestion rate for children (ages 1-6 years) was assumed to be 100 mg/day.

Risk Calculations

Intermediate-term and short-term MOEs were calculated as follows:

$$MOE = \frac{NOAEL}{ADD}$$

In summary, the short- and intermediate-term MOEs are greater than or equivalent to 100 for the following ULV aerial and ground-based fogger mosquito and blackfly applications.

- Dermal contact for adults and toddlers for mosquito aerial applications.

- Dermal contact for adults and toddlers for all ground-based foggers;

- Hand-to-mouth exposures for aerial and ground-based foggers for all application rates;

- Object-to-mouth for aerial and ground-based foggers for all application rates; and

- Incidental soil ingestion for aerial and ground-based foggers for all application rates;

The short- and intermediate-term MOEs are less than 100 for the following ULV aerial blackfly applications:

- Dermal contact for adults and toddlers for blackfly aerial applications.

Characterization of Exposure and Risk

The above risks are based on a screening-level assessment to ensure that the exposure/risk is not underestimated. Although this is regarded as a screening-level assessment, attempts were made to use a reasonable deposition rate determined from the literature and the Ag Drift model. The adult and toddler dermal exposure scenario for blackfly treatments, the only scenario with MOEs less than 100, is believed to be a conservative estimate and a more refined assessment

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could be completed with (1) chemical-specific deposition data for the aerial applications; (2) application timing for blackfly treatments (e.g., if applications were made in the evening then residue dissipation could be accounted for in the exposure assessment); (3) HED is currently revising the Residential SOPs including the assumptions used in estimating the dermal exposure route; and (4) either a dermal absorption study or a new dermal toxicity study with a better defined NOAEL. The toxicological endpoint and its impact on the reported MOEs are described below.

Since a 28-day dermal toxicity study in rats (MRID00160750) was available from the toxicology database, a NOAEL of 1.0 mg/kg is used for the short-and intermediate-term risk assessments, based on plasma, red blood cell and brain cholinesterase inhibition occurring at 20 mg/kg (LOAEL). A similar NOAEL of 1.0 mg/kg was determined in a 28-day oral toxicity study in rats (MRID 00088871) with plasma and brain cholinesterase inhibition occurring at 10 mg/kg. As stated in the February 24 ,1999 *Report of the Hazard Identification Assessment Review Committee* (HED Doc. NO. 013270), by comparing the same toxicological endpoints (cholinesterase inhibition) in the same species (rat) in the oral and dermal studies, the estimated dermal absorption factor for naled was 100 percent. However, this is likely to be an overestimate of the dermal absorption factor for naled. The structure activity relationship of closely related structural analogs, dichlorvos, which measured a dermal absorption factor of 11 percent and trichlorfon, which had an estimated dermal absorption factor of 10 percent also support a likely overestimation. Naled has similar physicochemical properties as dichlorvos and trichlorfon and is likely to have similar dermal absorption properties. If the dermal absorption factor for naled is similar to the other two analogs, then there would be less concern for dermal MOEs of less than 100. For example, the adult and toddler MOEs for the dermal contact on lawns are approximately 50 for the blackfly treatments, which would greatly increase based on defining the dermal absorption. To better characterize dermal absorption, it is recommended that a dermal absorption study in rats be conducted or another 28-day dermal toxicity study in rats be conducted using doses which will better define the NOAEL and the LOAEL.

cc: Susan Hummel

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Table 1. Naled Residential Postapplication Estimated Risks Resulting from ULV Aerial and Ground-based Fogger Mosquito and Blackfly Applications.

Scenario	Receptor	Application Rate Per Treatment (AR) (lbs ai/A)	DFR (ug/cm^2)[a]	GRt (ug/cm^2)[b]	SRt (ug/g)[c]	Transfer Coefficient (Tc) (cm^2/hr)	Exposure Time (ET) (hrs/day)	Surface Area (SA) (cm^2/ event)	Freq. (FQ) (events/ hr)	IgR (cm^2/day) or (mg/day)[d]	BW (kg)	Dermal Dose (mg/kg/day)[e]	MOE[f]
Dermal exposure	Adult	0.02 (Ground)	0.00062	-	-	43,000	2	-	-	-	70	0.00069	1,500
		0.05 (Aerial mosquito)	0.0084									0.010	97
		0.1 (Aerial blackfly)	0.017									0.021	48
Dermal exposure	Toddler	0.02 (Ground)	0.00062	-	-	8,700	2	-	-	-	15	0.00065	1,500
		0.05 (Aerial mosquito)	0.0084									0.0097	100
		0.1 (Aerial blackfly)	0.017									0.019	51
Hand-to-Mouth	Toddler	0.02 (Ground)	0.0022	-	-	-	2	350	1.56	-	15	0.00016	6,100
		0.05 (Aerial mosquito)	0.034									0.0024	410
		0.1 (Aerial blackfly)	0.067									0.0049	200
Object-to-mouth	Toddler	0.02 (Ground)	-	0.0022	-	-	-	-	-	25	15	3.7E-6	2.7E+5
		0.05 (Aerial mosquito)		0.034								5.6E-5	18,000
		0.1 (Aerial blackfly)		0.067								0.00011	8,900
Incidental soil ingestion	Toddler	0.02 (Ground)	-	-	0.0075	-	-	-	-	100	15	5E-8	2E+7
		0.05 (Aerial mosquito)			0.113							7.5E-7	1.3E+6
		0.1 (Aerial blackfly)			0.225							1.5E-6	6.7E+5

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Note: The ground-based fogger rate is 0.02 lb ai/acre for mosquitos, the aerial rate is 0.05 lb ai/acre for mosquitos in residential areas, and 0.1 lb ai/acre for blackflies in residential areas. Calculations were performed in spreadsheets, therefore, rounding errors may have occurred.

a Dislodgeable foliar residue (ug/cm^2) = [AR (lbs ai/A) * 30 percent aerial and 5 percent ground-based foggers * fraction ai available as dislodgeable (5 % dermal and 20% oral exposures) * 4.54E+8 ug/lb * 2.47E-8 A/cm^2]

b "Object" residue (GRt) (ug/cm^2) = [AR (lbs ai/A) * 30 percent aerial and 5 percent ground-based foggers * fraction ai available on a toy or grass as dislodgeable (20%) * 4.54E+8 ug/lb * 2.47E-8 A/cm^2]

c Soil residue (SRt) (ug/g) = [AR (lbs ai/A) * 30 percent aerial and 5 percent ground-based foggers * fraction ai retained on soil (100 %) * 4.54E+8 ug/lb * 2.47E-8 A/cm^2 * 0.67 cm^3/g soil]

d Ingestion rate: cm^2/day for grass ingestion, and mg/day for incidental soil ingestion.

e Daily dermal dose (mg/kg/day)
Dermal exposure: = [DFR (ug/cm^2) * Tc (cm^2/hr) * mg/1,000 ug * ET (hrs/day) * absorption factor (1.0)] / [BW (kg)];
Hand-to-mouth: = [DFR (ug/cm^2) * SA (cm^2/event) * FQ (events/hr) * mg/1,000 ug * ET (2 hrs/day)] / [BW (kg)];
Turfgrass ingestion: =[GRt (ug/cm^2) * IgR (cm^2/day) * mg/1,000 ug] / [BW (kg)]; and
Incidental soil ingestion: = [SRt (ug/g) * IgR (mg/day) * g/1,000,000 ug] / [BW (kg)].

f MOE = 28-day oral rat study and 28-day dermal rat study NOAELs (both 1 mg/kg/day) / ADD. Uncertainty factors for oral and dermal routes are both 100.